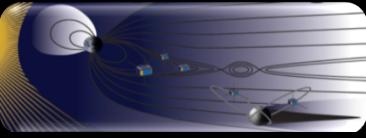


# LUNAR PICKUP ION OBSERVATIONS FROM ARTEMIS

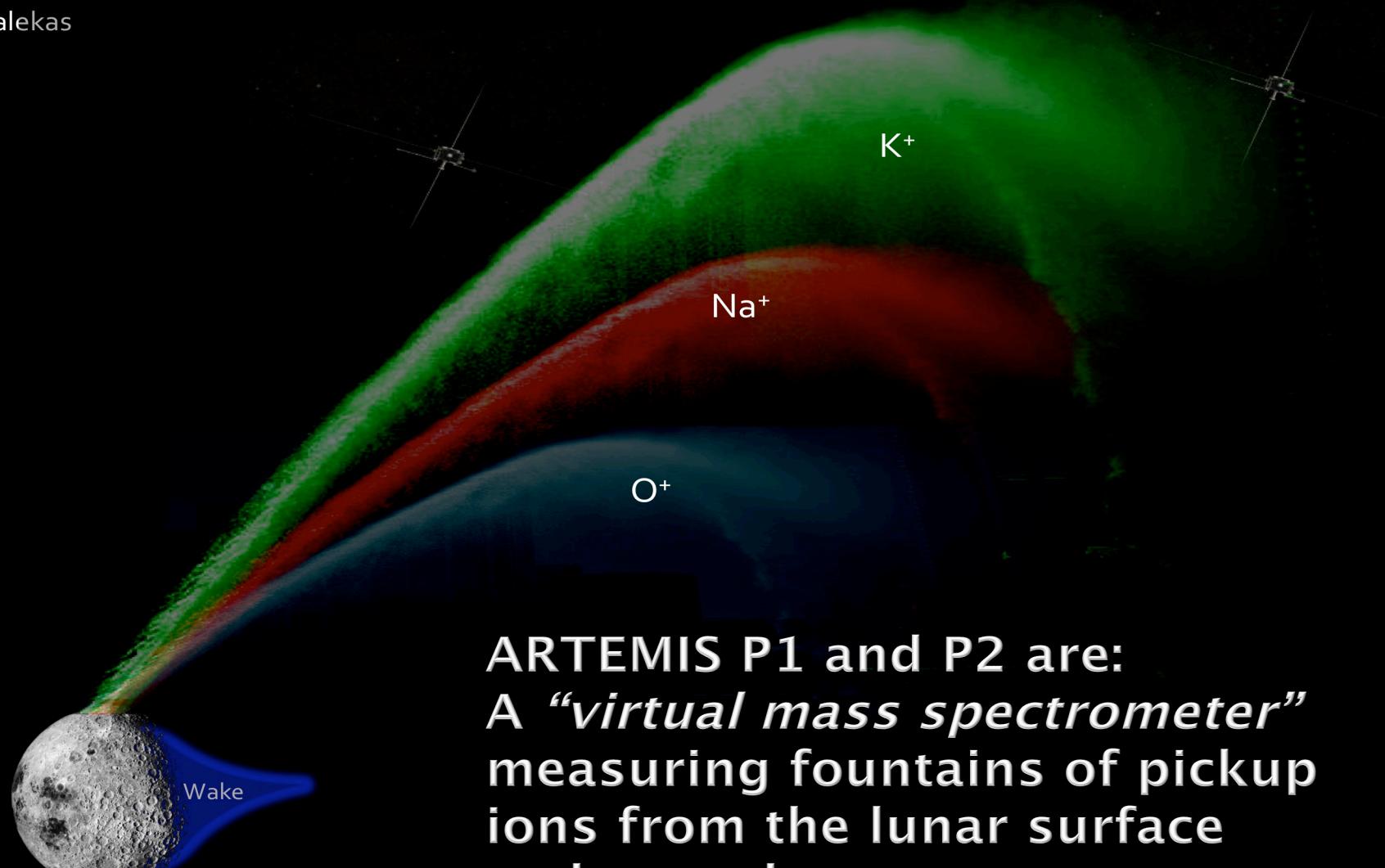
J.S. HALEKAS: U.C. BERKELEY SPACE SCIENCES LABORATORY  
• DREAM LUNAR SCIENCE INSTITUTE TEAM  
• ARTEMIS TEAM



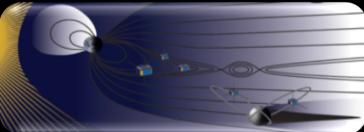
# Lunar Pickup Ions



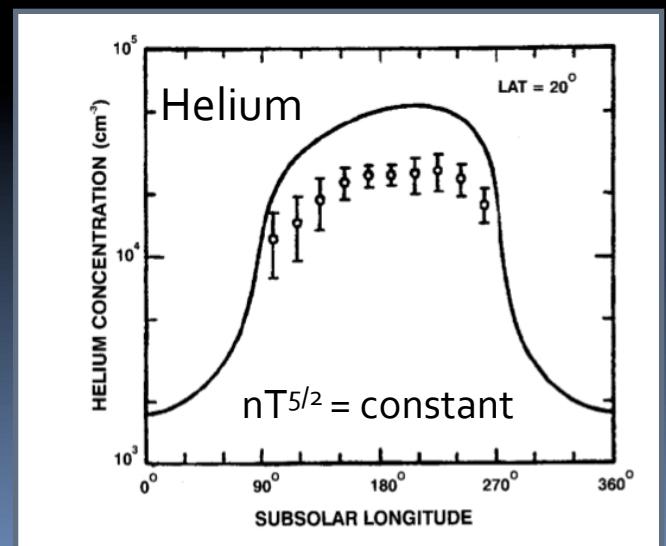
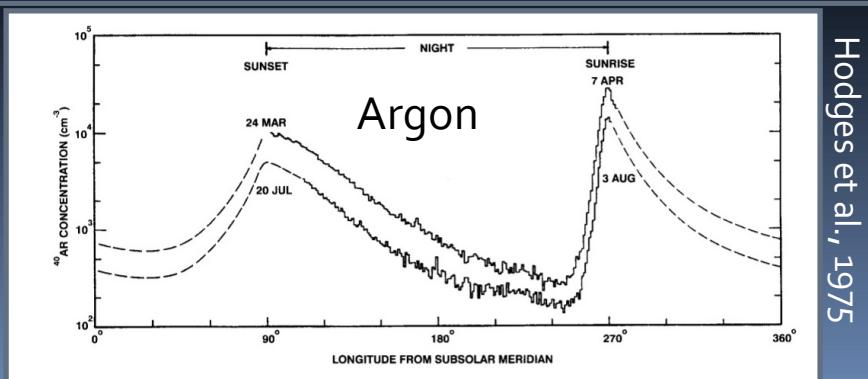
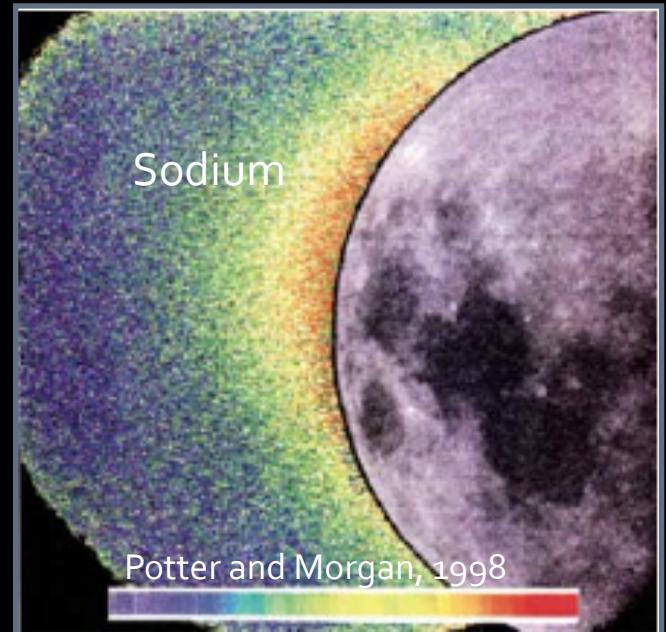
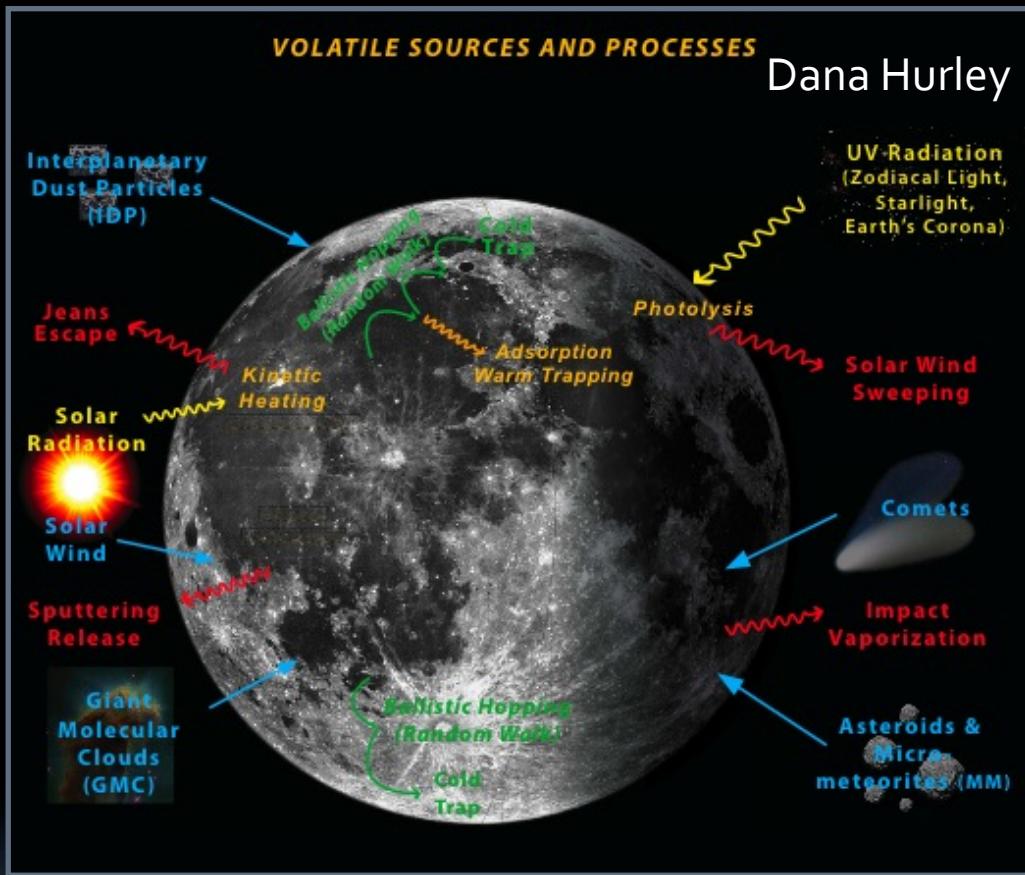
Credit: J.S. Halekas  
U.C. Berkeley

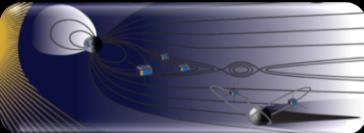


ARTEMIS P1 and P2 are:  
A “*virtual mass spectrometer*”  
measuring fountains of pickup  
ions from the lunar surface  
and exosphere



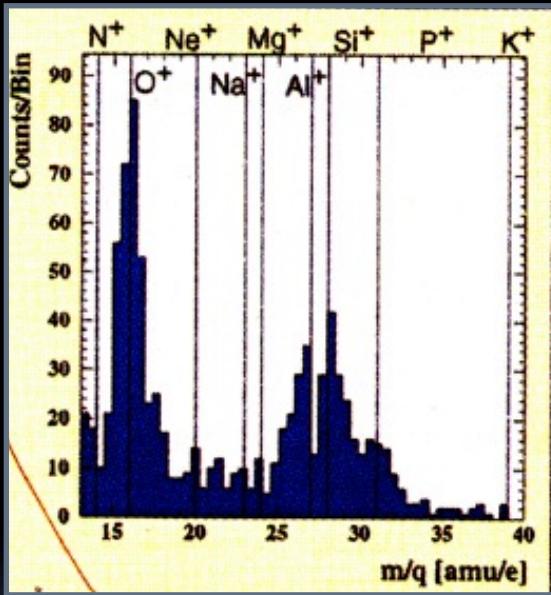
# Lunar Exosphere



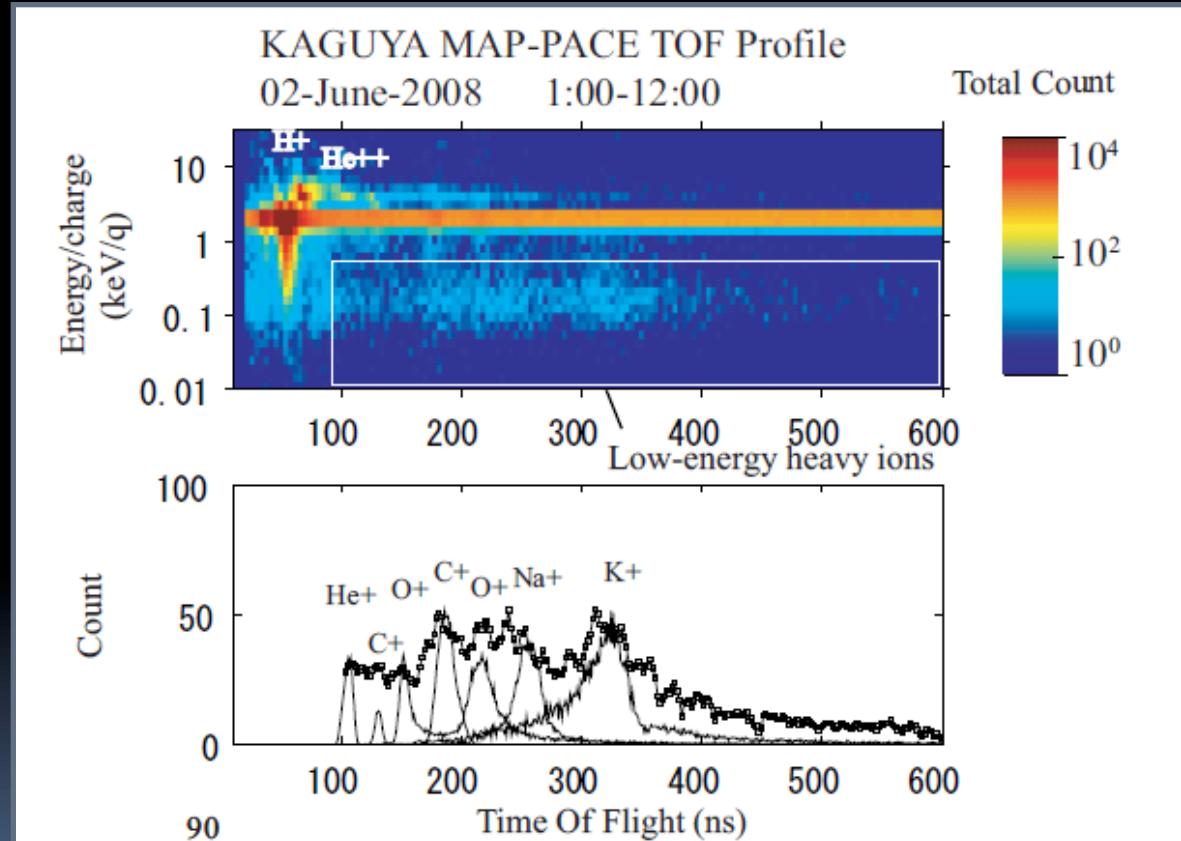


# Some Previous Lunar Pickup Ion Measurements

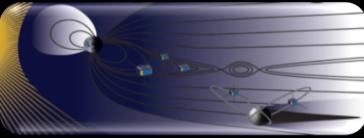
Wind



Kaguya

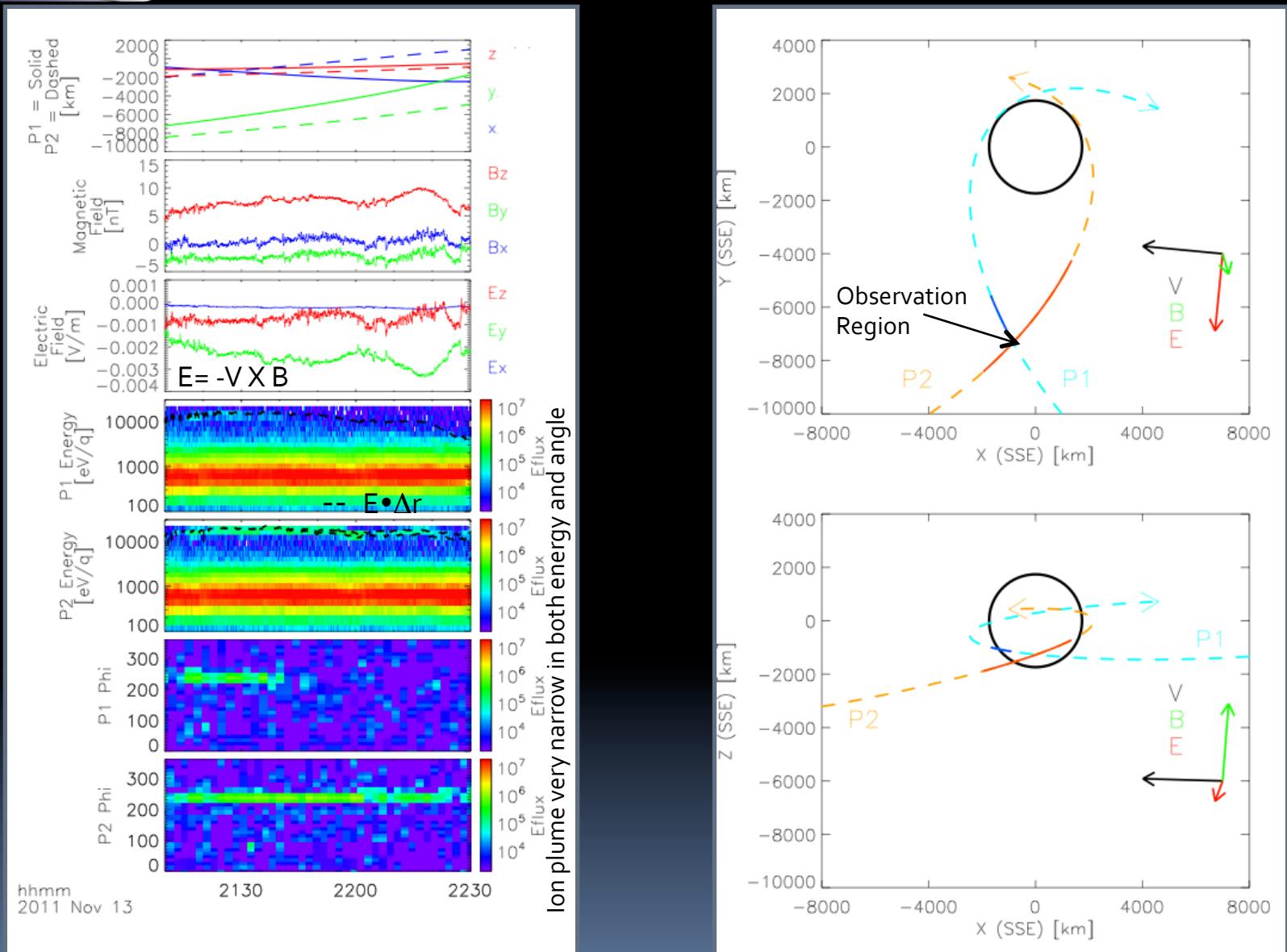


- ARTEMIS fills a gap between very far away (Wind, AMPTE) and very close (Kaguya, Chang'E)
- Now we can see ions in between their initial acceleration and many gyrations downstream

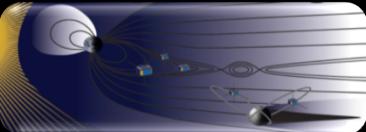


# ARTEMIS Observations

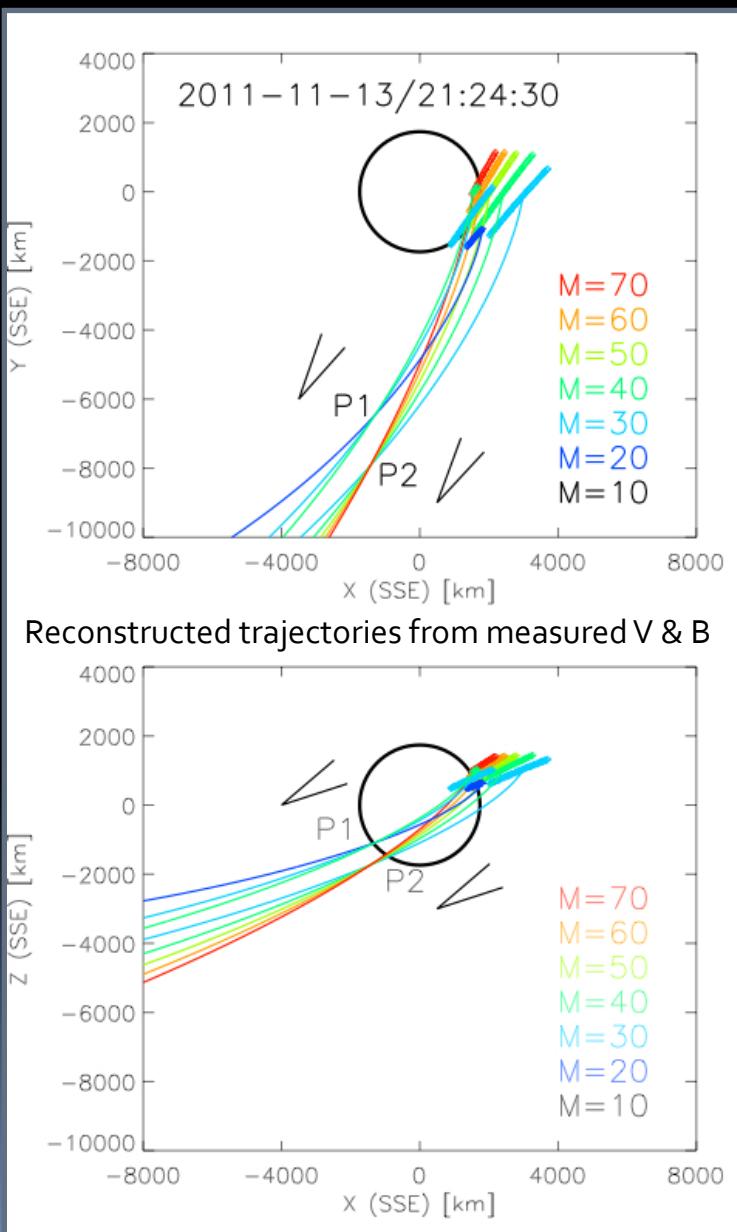
## Simultaneous P1/P2 Observation



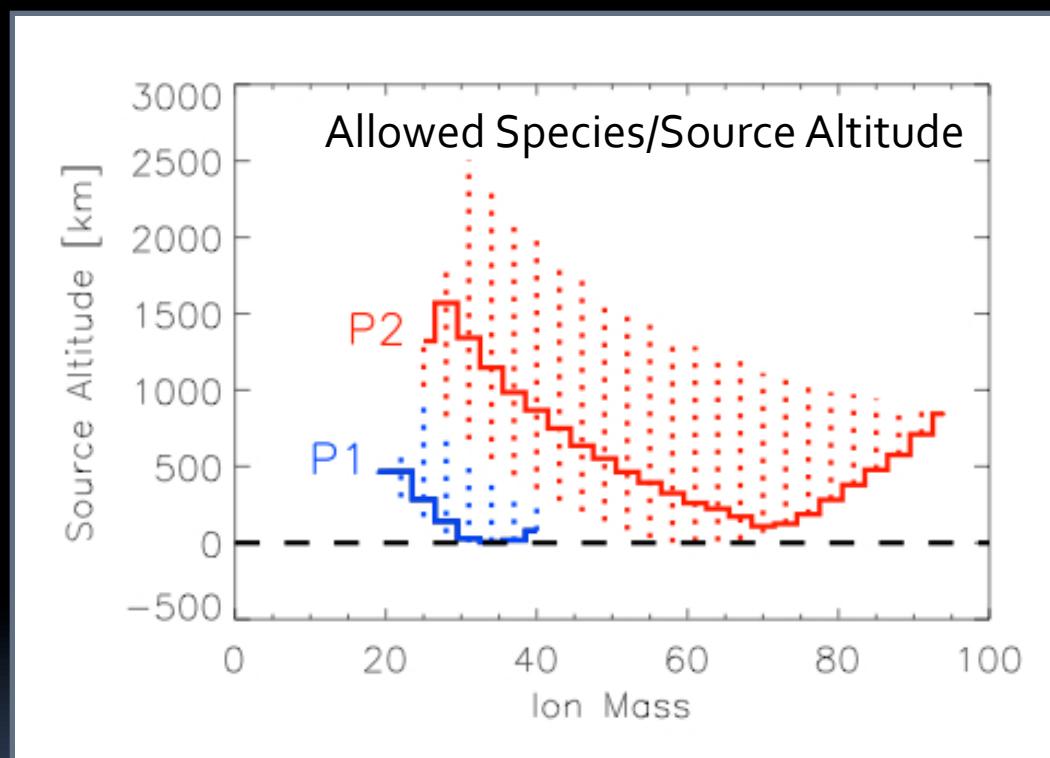
- Mid distance, in first gyration, narrow in energy/angle, unknown species (no mass resolution)
- Ions only seen when electric field points in right direction (large B<sub>z</sub> => large E<sub>y</sub>)



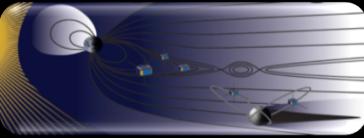
# Virtual Mass Spectrometer



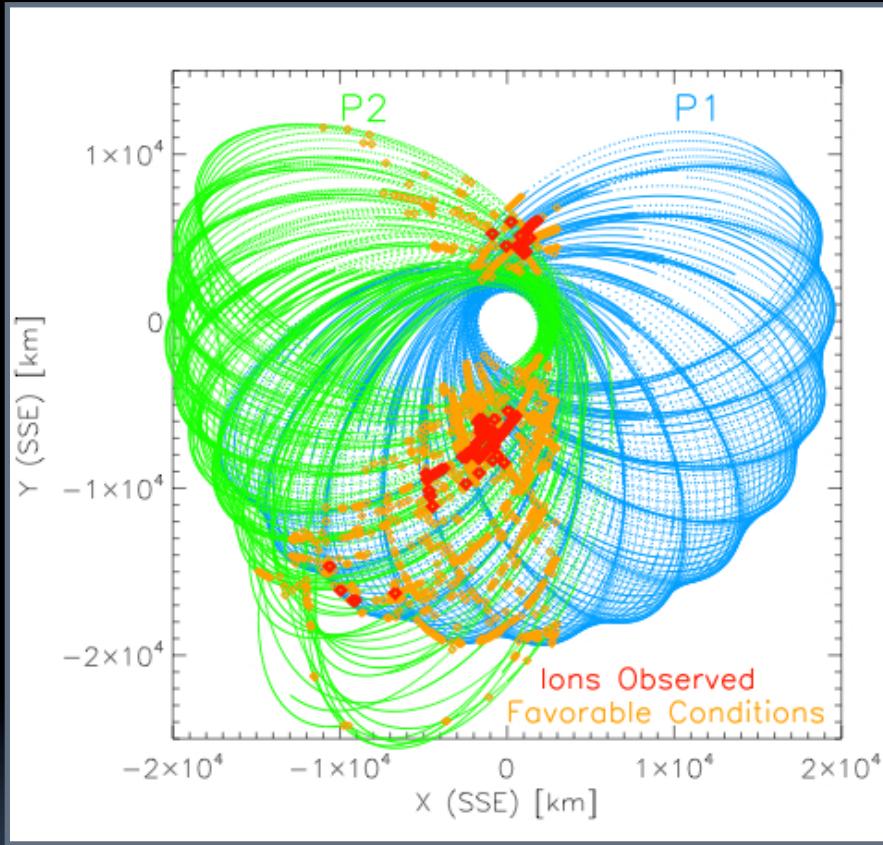
Only certain pickup species can reach ARTEMIS in the right energy/angle bin => limited mass discrimination



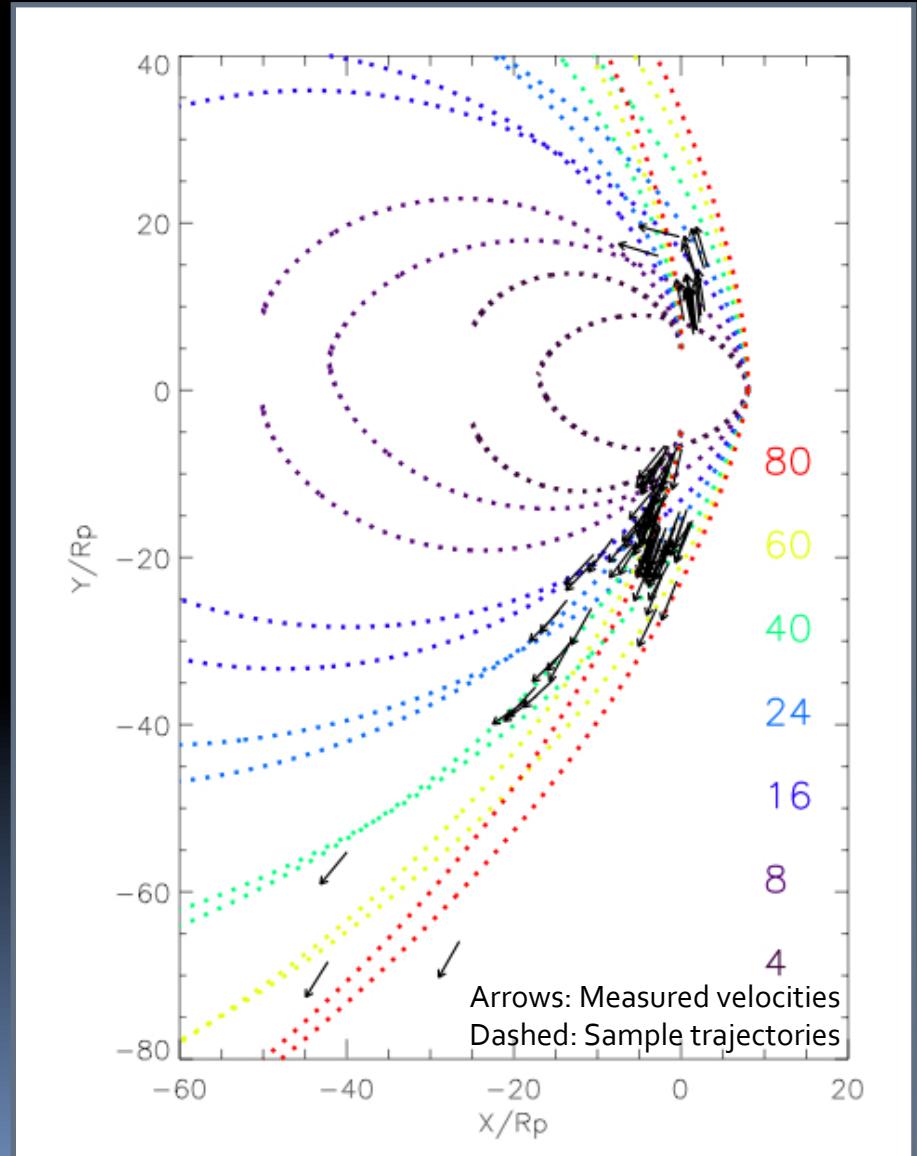
Extended source with  $M \sim 20-40$  favored if both ARTEMIS probes are seeing same population of ions

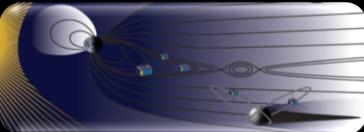


# Distribution of Observations and Observation Opportunities



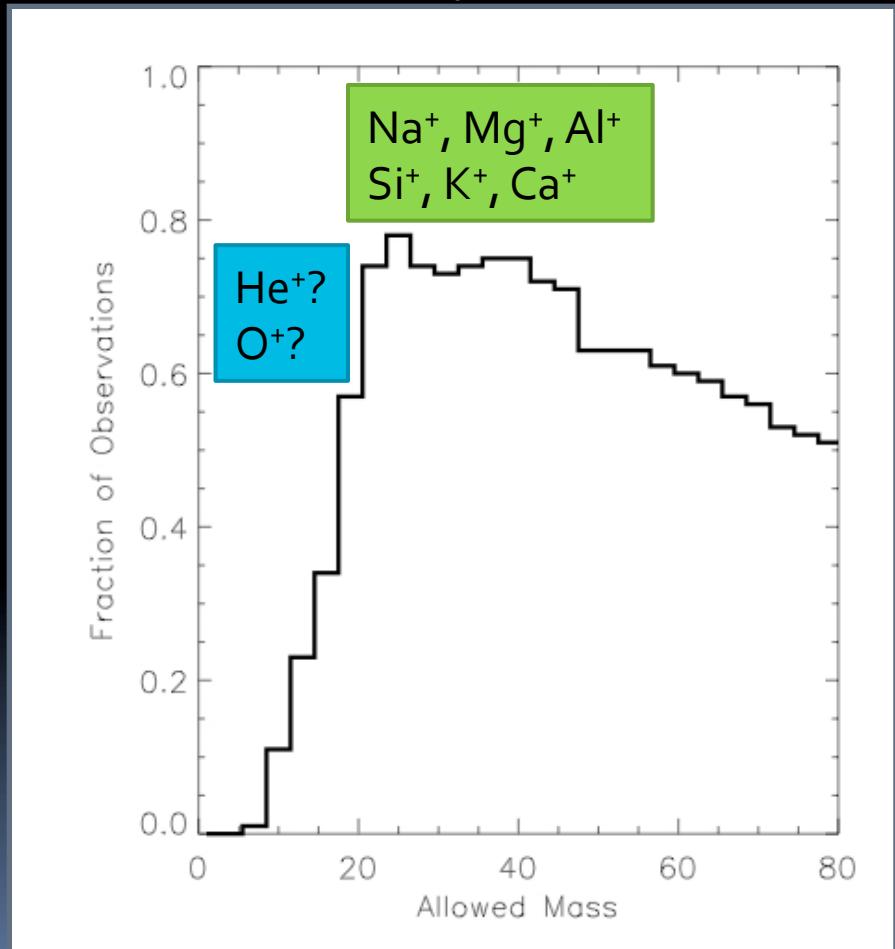
Location of ARTEMIS observations and velocity directions consistent w/ mass 20-40



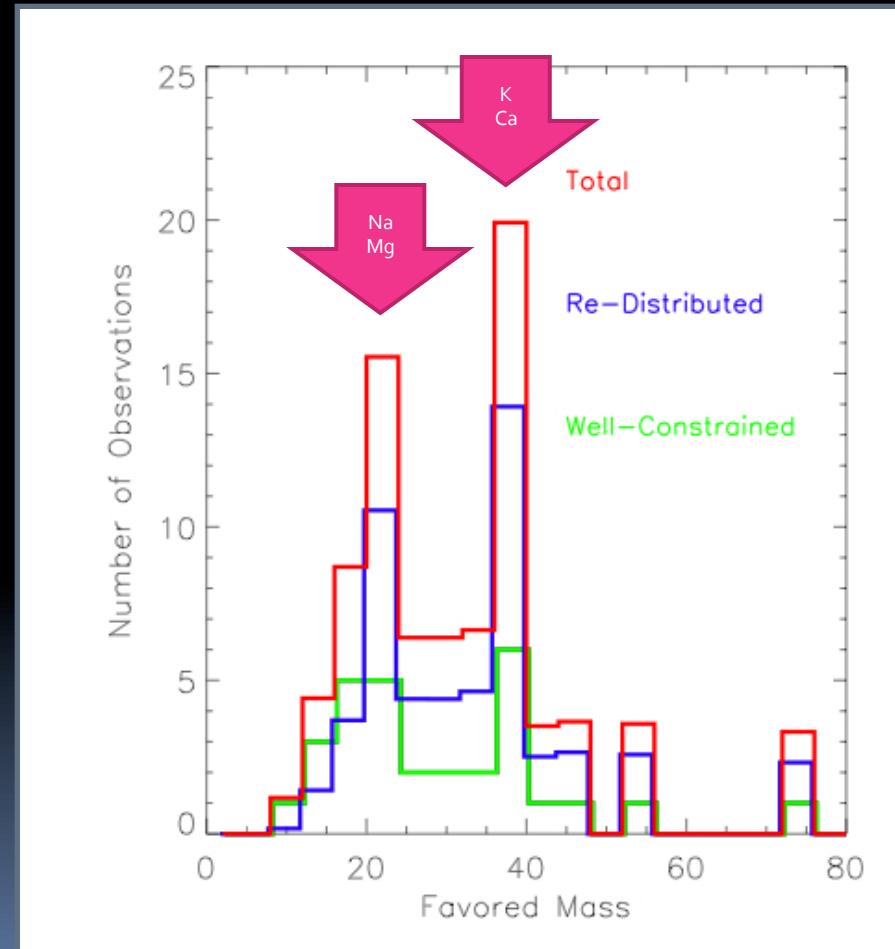


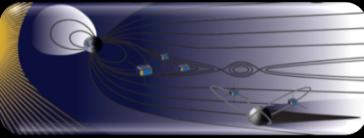
# Species Identification

Allowed Species

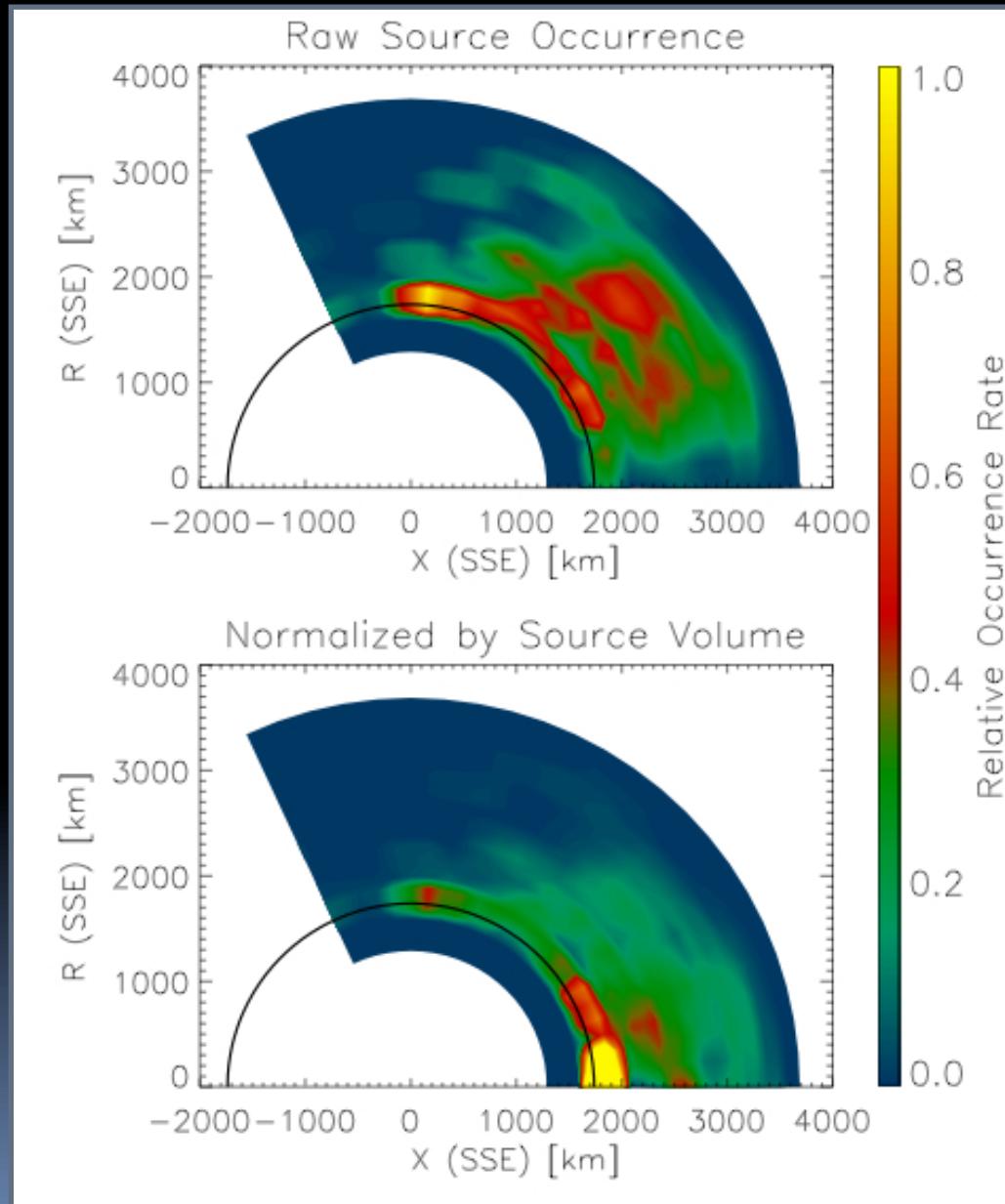


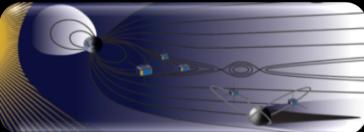
Favored Species  
(assuming lowest start altitude most likely)



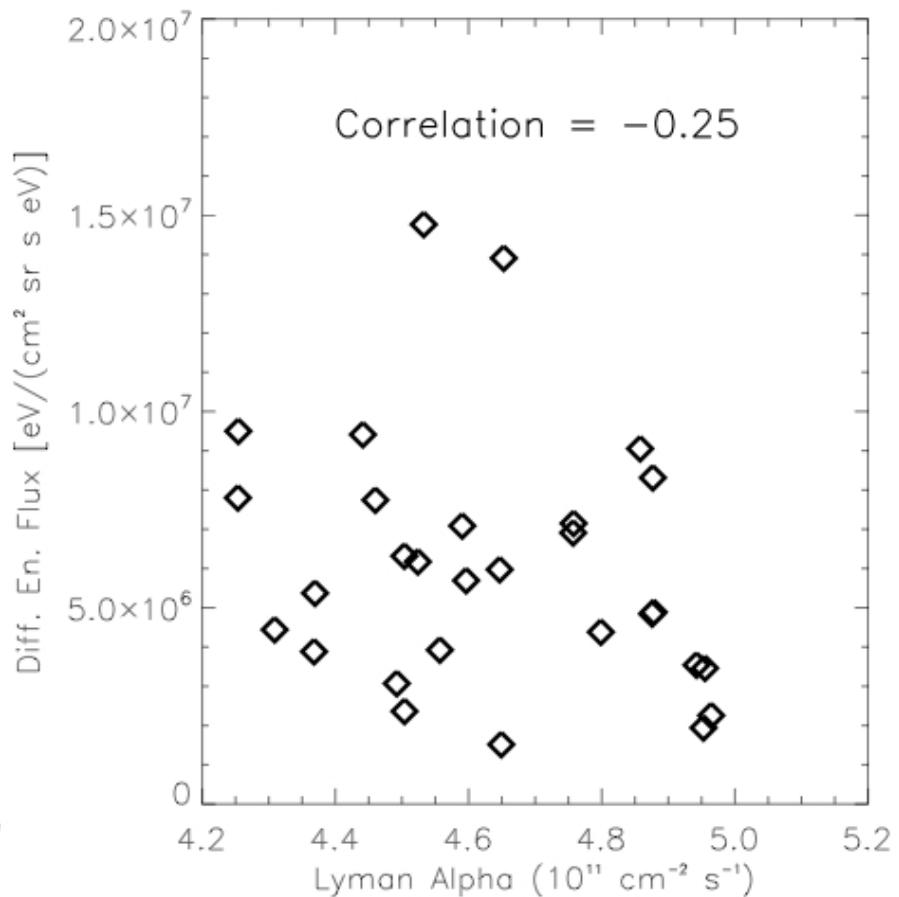
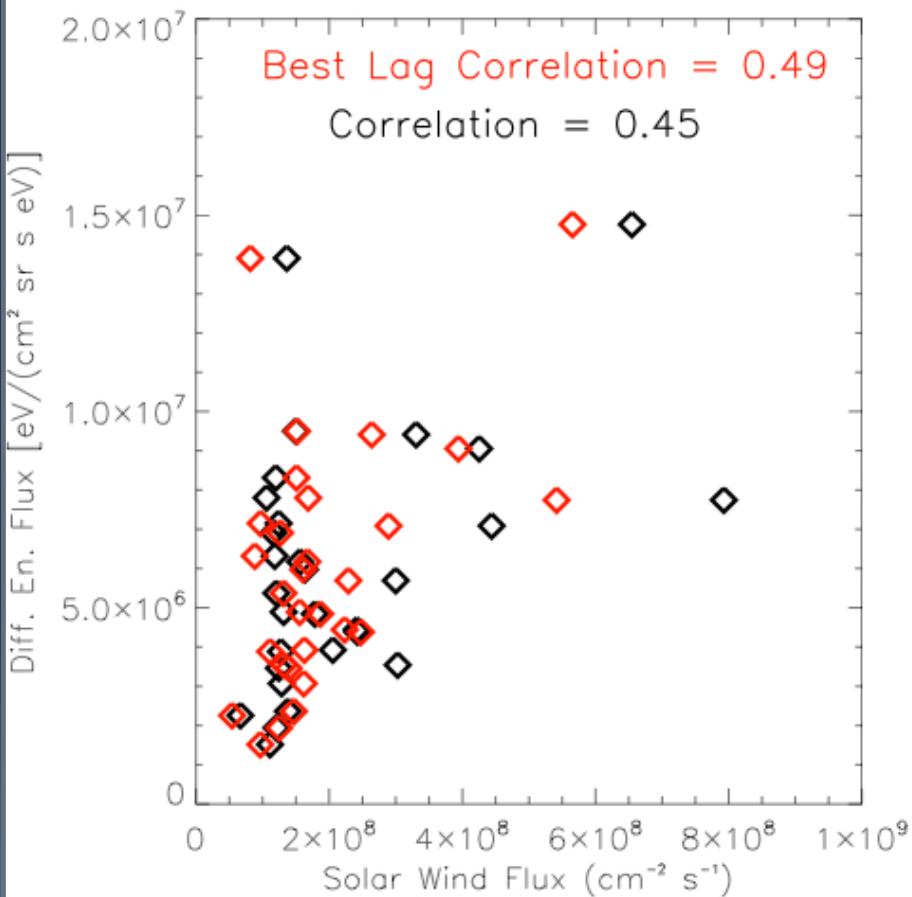


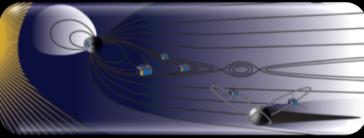
# Favored Source Locations



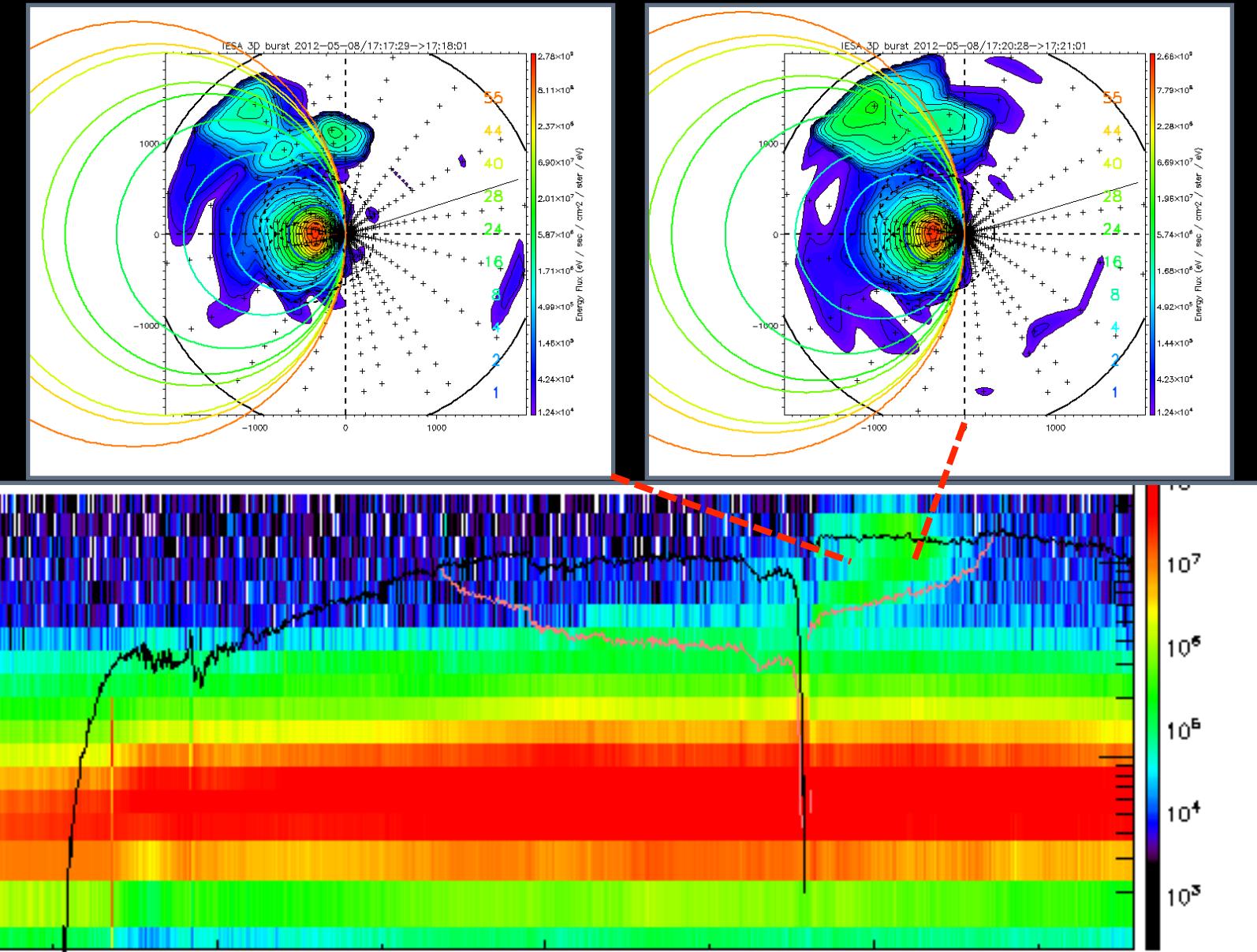


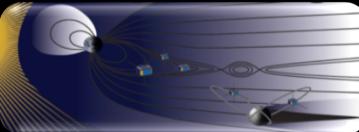
# Production Mechanism



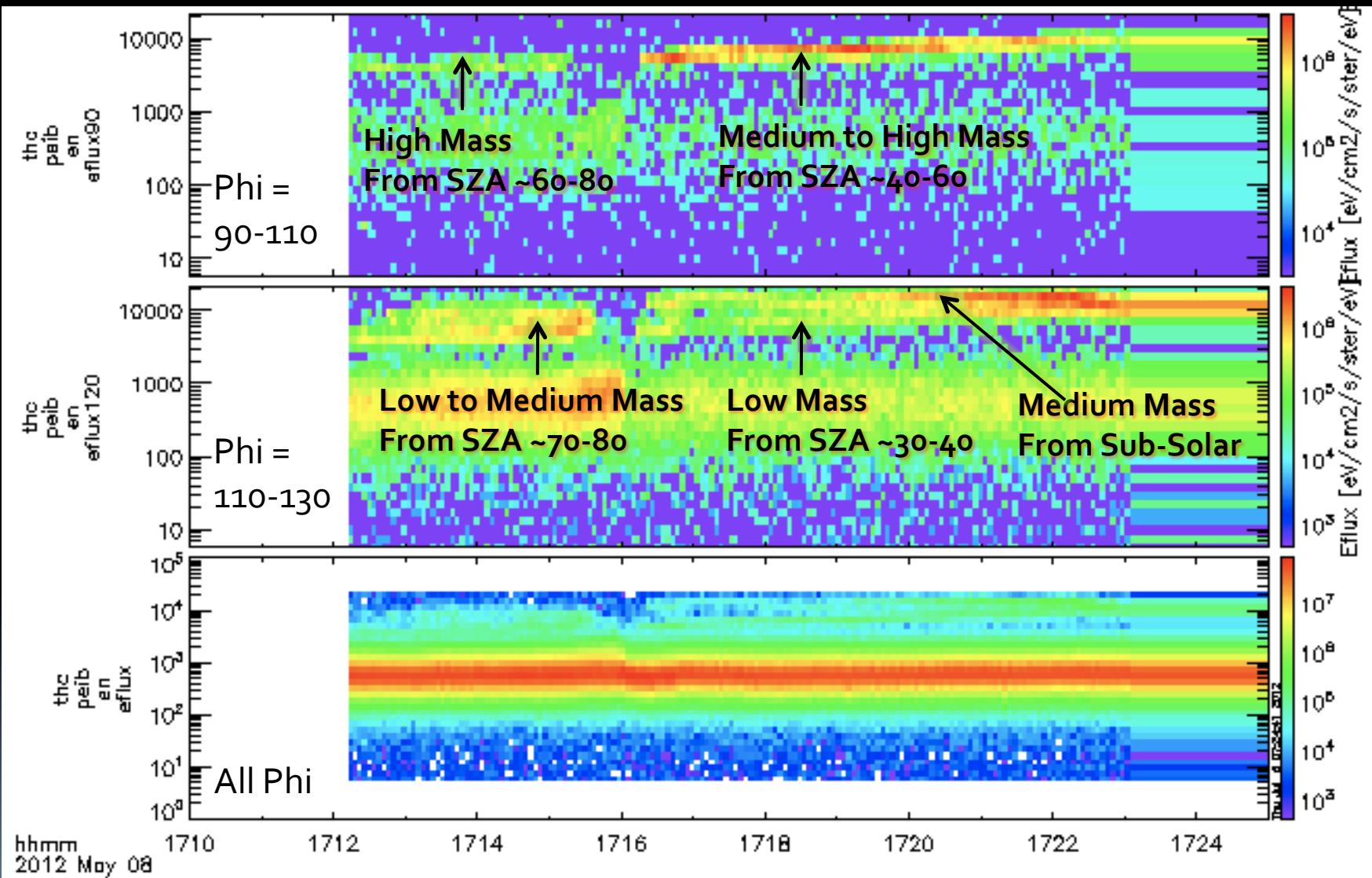


# Multiple Species/Origins

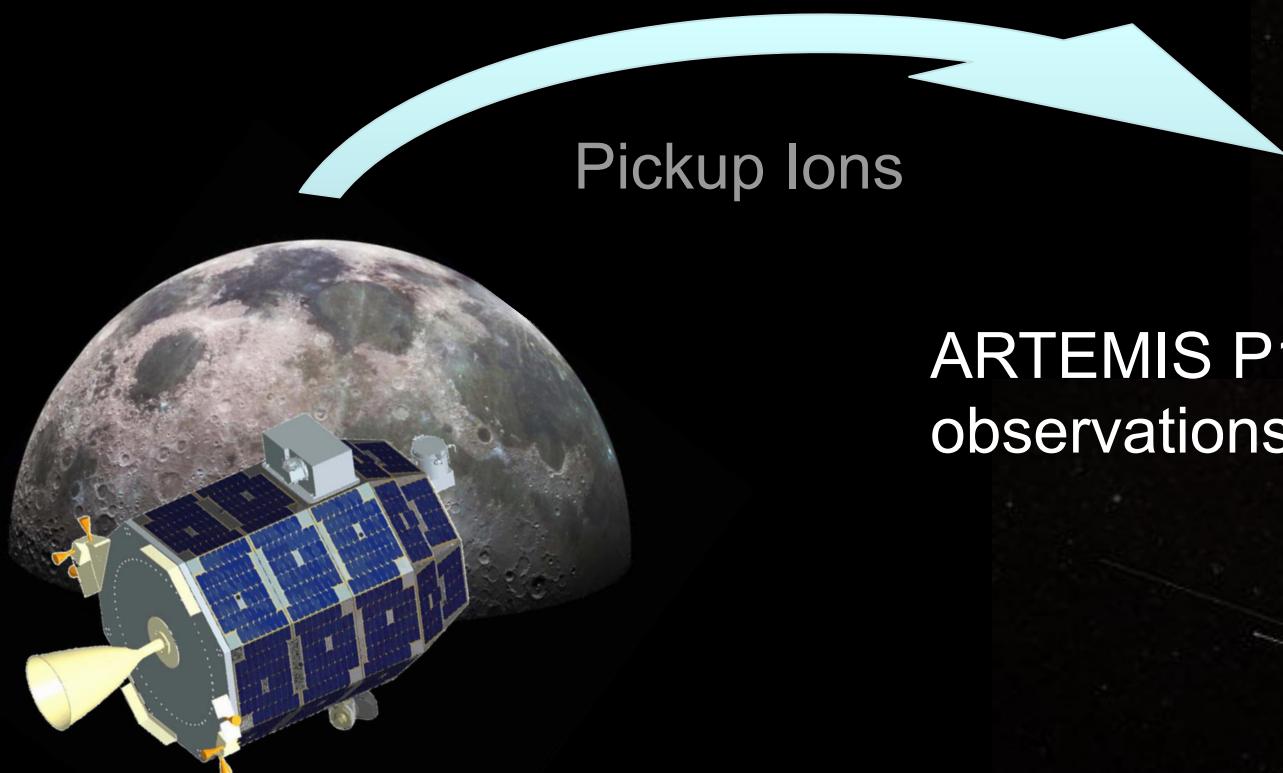




# Multiple Species/Origins



# ARTEMIS and LADEE: A Powerful Team to Study the Lunar Atmosphere



ARTEMIS P1 & P2: Remote observations of ionized species

LADEE: Direct and spectroscopic observations of neutral species

